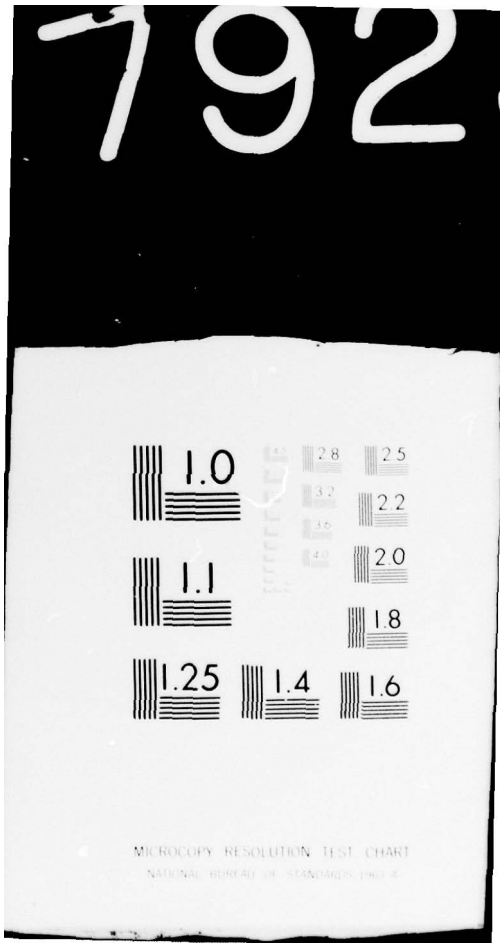
AD-A079 235 ARMY PERSONNEL RESEARCH OFFICE WASHINGTON DC F/G 5/9
VALIDITY ANALYSIS OF TOOL AND TRADE KNOWLEDGE TEST ITEMS. (U)
MAY 64 W H HELME , W R GRAHAM
UNCLASSIFIED APRO-RM-64-5 NL

| OF |
AD A079235L

END
DATE FILMED
2-80
DDC


792
1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

Research Memorandum 64-5

VALIDITY ANALYSIS OF TOOL AND TRADE KNOWLEDGE TEST ITEMS

May 1964

U. S. ARMY PERSONNEL RESEARCH OFFICE

(14) APRO-RM-64-5

Army Project Number
2J024701A722

New Classification Tech 8-33

(9) Research Memorandum 64-5

(6) VALIDITY ANALYSIS OF TOOL AND TRADE KNOWLEDGE TEST ITEMS.

(10) William H. Helme and Warren R. Graham

(12) 29

Submitted by:
Edmund F. Fuchs
Chief, Military Selection
Research Laboratory

Approved by:
J. E. Uhlaner
Director, Research
Laboratories

(11) May 1964

040650

VALIDITY ANALYSIS OF TOOL AND TRADE KNOWLEDGE TEST ITEMS

BACKGROUND

The Army Classification Battery (ACB) consists of 11 tests of varied content, designed to provide the basis for optimal differential classification of enlisted men for training in Military Occupational Specialties (MOS). Most of the tests were originally constructed and standardized during World War II. Research has been conducted continuously since 1949 to maintain and improve the ACB, to check the validity of tests and composites, and to extend the scope of the battery's effectiveness to additional MOS. New tests have been introduced and new forms have replaced existing tests to avoid obsolescence of content and to counter growing familiarity of examinees with test content. Research has yielded replacement measures for the Verbal, Arithmetic Reasoning, and Electronics Information Tests in 1957, and for the Army Clerical Speed Test and Automotive Information Test in 1962. Two new measures, the Classification Inventory and the General Information Test, were introduced in 1958. The remaining four tests--Pattern Analysis, Mechanical Aptitude, Army Radio Code Aptitude, and Shop Mechanics--have been unchanged since the inception of the ACB. The present study constituted a step toward replacement of two measures used for classification to MOS in the mechanical domain: Mechanical Aptitude (MA), a component of the Electronics and Motor Maintenance Aptitude Areas, and Shop Mechanics (SM), a component of the General Maintenance Aptitude Area.

When ACB measures are to be replaced, the question arises as to whether up-to-date parallel forms of existing tests or measures of a new and different type would most improve the differential validity of the battery. The crucial consideration is not the zero-order validity of the measure to be replaced, but its validity for differential classification. In a comprehensive study of ACB validity for 73 Army School MOS courses across all non-combat occupational areas (Helme, 1960), "The Mechanical Aptitude Test and the Shop Mechanics Test appeared to offer little prospect of differential selection within the broad mechanical field. Replacements for these tests should be based on a realignment of existing content, and on inclusion of content more pertinent to specific mechanical job areas." An experimental Tool Knowledge Test, emphasizing aptitude for working with mechanical tools and processes rather than comprehension of mechanical and physical principles, and two experimental Trade Knowledge tests designed to differentiate as well as possible among Precision Maintenance occupational job areas, and among various military crafts jobs such as Construction (Mos with first two digits 51), Chemical (53), and fuel and industrial gas production (57), were constructed (Helme, Kotula, Tracey and Anderson, April 1960) for possible inclusion in the ACB.

CONSTRUCTION OF EXPERIMENTAL MECHANICAL INFORMATION TESTS

THE ITEM POOLS

To provide content more pertinent to specific job areas within the broad mechanical domain, a large pool of items of mechanical information was constructed with the assistance of Army enlisted subject matter experts and the use of both military and civilian technical manuals. These experimental items were based on selected groups of MOS not specifically represented in the content of MA and SM: Wire Maintenance, Electrical Equipment Maintenance, Construction, Utilities, Fuel and Industrial Gas Production, and Engineer Equipment Operation and Maintenance. A small set of general content tool items, common to a wide range of mechanical jobs, was added. While these measures were designed to replace and extend the mechanical information content of MA and SM, no items on physical and mechanical principles--which make up 67 percent of MA and 35 percent of SM--were included. Table 1 shows the composition of the three experimental forms by content area. After editing, revision, and allocation of items to content area in rough proportion to annual personnel replacement requirements, the items were assembled in three experimental tests:

1. Tool Knowledge, TK-1X (PT 3961). 120 items, of which about two-thirds involve recognition of pictures of tools and association with use. The remainder are verbal questions on tools.

2. Trade Knowledge, TRK-1X (PT 3963). 110 items on specific trade operations, of which about one-fourth involve illustrations.

3. Trade Knowledge, TRK-1Y (PT 3965). A form parallel in content and format to TRK-1X.

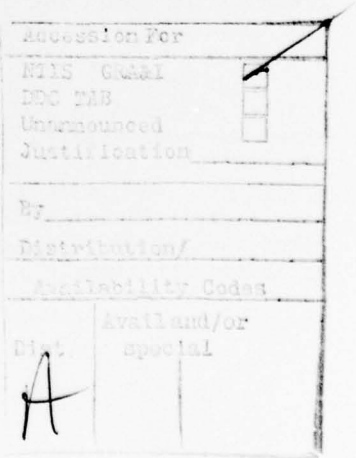
SCOPE OF PRESENT ANALYSIS

The objective of the present analysis was to develop experimental scales for the differential prediction of performance in construction and related mechanical jobs. The present report covers analysis of items for (1) difficulty level in samples representative of the Army input population and (2) validity for performance in selected electrical maintenance and engineer construction training courses. A necessary intermediate step in the analysis was to determine whether item statistics in relatively small samples representative of individual MOS or MOS of near equivalent requirements would be sufficiently stable to constitute a basis for predictive scales which could be cross validated in subsequent studies.

Table 1

DISTRIBUTION OF TOOL AND TRADE KNOWLEDGE ITEMS BY CONTENT CATEGORY

Content Category	Tool Knowledge Items (Form TK-1X)	Trade Knowledge Items (Forms TRK-1X, TRK-1Y)
Electrical	15	48
Carpentry	39	36
Plumbing, Heating, Refrigeration	15	28
Masonry, Quarrying	16	28
Construction Machinery Operator	--	28
Water and Industrial Gas Supply	--	16
Rigging	--	20
Steel Structures Construction	--	16
Machinist	5	--
Painting and Paperhanging	6	--
Miscellaneous	24	--
Totals	120	220



PROCEDURE

DATA COLLECTION

The three experimental forms were administered to a sample of general enlisted input and samples of input to MOS training programs from September 1960 to September 1961 at the Reception Station and Engineer Training Center, Fort Leonard Wood, Missouri; the Engineer School, Fort Belvoir, Virginia; and the Southeastern Signal School, Fort Gordon, Georgia. The Reception Station (general input) sample was tested at the time of ACB testing; the MOS training input sample were tested just prior to beginning the respective training programs. Each examinee was given the Tool Knowledge Test and one of the Trade Knowledge forms. In addition, scores on ACB tests were obtained from the Enlisted Qualification Record, DA Form 20. From examinees administered each of the two Trade Knowledge Tests, five MOS samples were initially set up (Table 2).

ITEM SELECTION

For each validation sample, A-1 through A-5 and B-1 through B-5, point biserial correlation coefficients of each item response with final course grade were obtained. In each of these samples, and in the general enlisted input samples, A-6 and B-6, the proportions giving each response were determined.

In selecting items, the initial step was to eliminate from consideration all items answered correctly by less than 10 percent or more than 90 percent of the general input samples. (In 4-choice items, the uncorrected p-values corresponding to 10 percent and 90 percent are .325 and .925, respectively.) By these standards the Tool Knowledge Test was reduced from 120 to 100 items and the two 110-item Trade knowledge Tests TRK 1X and 1Y to 85 and 75 items, respectively.

The second step was to identify items with validity significantly different from zero in a positive direction in each sample. Table 3 shows that the number of items identified as valid in a given sample ranged from 12 to 71.

At this point it was necessary to marshal the evidence as to whether the item statistics, particularly on the TRK items in separate samples, were sufficiently stable for reliance in setting up experimental scales for subsequent cross validation. The question was of immediate importance in regard to developing Trade Knowledge test scales in MOS samples for which cross samples were not available in the present study. The two samples on which Tool Knowledge item data were obtained afforded an opportunity for estimating the stability of item indices obtained in such relatively small MOS samples. Results with the TK test which was administered to both A and B samples were examined to find to what extent the same items were identified as valid in two samples with the same MOS criterion. Statistical significant correspondence was found only between two of the largest samples (MOS 120) (Table 4). This finding suggested that sets of items identified on single small samples might well fail to maintain validity in an independent sample.

Table 2

ITEM ANALYSIS SAMPLES FOR TOOL AND TRADE KNOWLEDGE TESTS

MOS		Tool Knowledge 1X / Trade Knowledge 1X Sample	N	Tool Knowledge 1Y / Trade Knowledge 1Y Sample	N
120	Pioneer	A-1	107	B-1	179
310	Field Communications Crewman	A-2	77	B-2	62
321	Lineman	A-3	105	B-3	112
511	Carpenter	A-4	54	B-4	48
512	Structures Specialist				
513	Mason				
523	Refrigeration Specialist				
526	Water Supply Specialist				
626	Construction Machine Operator	A-5	81	B-5	59
627	Crane Shovel Operator				
006	Trainee (General input)	A-6	440	B-6	453

Table 3

NUMBER OF ITEMS IN TOOL AND TRADE KNOWLEDGE TESTS SIGNIFICANTLY VALID ($P < .05$) FOR EACH SAMPLE

MOS	Sample	TK-1X	TRK-1X	Sample	TK-1X	TRK-1Y
120	A-1	44	23	B-1	56	40
310	A-2	47	34	B-2	24	33
321	A-3	29	33	B-3	71	39
511[a]	A-4	33	24	B-4	34	23
626[a]	A-5	22	23	B-5	26	12

[a]Inasmuch as a majority of cases in each of these samples were in the MOS indicated, the MOS is used to represent the MOS group throughout the tables in this report.

Table 4

COMPARISON OF NUMBER OF TK ITEMS IDENTIFIED AS SIGNIFICANTLY VALID IN BOTH OF TWO INDEPENDENT SAMPLES

		Number of Significantly Valid Items In Common			
MOS	Samples	Expected	Observed	Chi-Square	p
120	A-1 vs B-1	24.64	30	5.76	.05
310	A-2 vs B-2	11.28	12	.12	-
321	A-3 vs B-3	20.59	21	.04	-
511	A-4 vs B-4	11.22	9	(1.00)[a]	-
626	A-5 vs B-5	5.72	9	3.26	.10

[a]Chi-Square in parenthesis indicates negative relationship.

While the job analysis had suggested grouping the MOS in the categories of Construction (120 and 511) and Electrical (310 and 321), the correlation or overlap of items found significantly valid (.05 level, one-tailed test) for each separate MOS was inspected for additional information useful to the grouping. Table 5 shows the correspondence in items identified as valid in every possible pair of samples. There was a definite trend toward better-than-chance correspondence between sets, 8 of the 40 comparisons showing significant (and positive) correspondence at the .05 level. To determine whether certain MOS sample pairs yielded consistently better correspondence than others, however, it was necessary to sum the chi squares across all four sample-and-test instances. Table 6 presents the results in terms both of chi square values and phi coefficients of correspondence. They indicate that there is a significant correspondence between MOS 120 and both 321 and 511, a lesser correspondence between MOS 310 and 321, and a borderline correspondence between these two MOS and 626. Considering that the phi coefficients represent a conservative estimate of the degree of correlation between item validity indices, the findings clearly showed that stable scales of valid items cannot be expected without basing them on multiple samples.

In general, the combination of MOS indicated by the job analysis was supported. From these results, MOS 321 could have been included in either the Construction or the Electrical group, a plausible finding in view of the nature of the Lineman's duties. Combining the Construction Machine Operation MOS (626 and 627) with the Construction and Utilities MOS was initially considered, but inspection of the item validity coefficients showed that there was little correlation between the two sets of coefficients. Therefore, MOS 626 and 627 were treated as a separate group. Decision was made to use three combinations of MOS in assembling the experimental scales: Construction, based on average item validity for MOS 120 and 511; Electrical, based on average item validity for MOS 310 and 321; and General, based on average item validity across all five MOS. In all, twelve scales were constructed--six TK and six TRK. Three scales for each measure were based on each sample. Owing to substantial differences in sample size, simple integral weights approximating proportions of cases provided by each MOS sample in each combination were used in averaging the coefficients. These weights were as follows:

A Samples, TK-1X and TRK-1X: MOS 120 and 321 (4), MOS 310 and 626 (3), MOS 511 (2)

B Samples, TK-1X and TRK-1Y: MOS 120 (3), MOS 321 (2), MOS 310, 511, and 626 (1).

Each scale was composed of the 25 items with highest average validity for the MOS combination. The scales are shown, with difficulty levels (p-values on samples A-6 and B-6 combined) and validity coefficients, in the tables in the Appendix, as are also distributions of validity coefficients for items selected and items rejected for each scale. Table 7 presents median p-values and medians of average validity coefficients across the MOS included in each scale. Median p-values in the B samples averaged .08 higher on the Tool Knowledge scales than in A.

Table 5

NUMBER OF ITEMS IDENTIFIED AS VALID IN BOTH OF TWO SAMPLES
FOR EVERY POSSIBLE TWO-SAMPLE COMPARISON

MOS	Samples	No. of Common Items: Expected	Observed	Chi-Square	Samples	No. of Common Items: Expected	Observed	Chi-Square
				TOOL KNOWLEDGE TEST				
120 vs. 310	A1, A2	20.68	23	.87	B1, B2	13.44	14	.07
321	A1, A3	12.76	15	1.03	B1, B3	39.76	46	7.67**
511	A1, A4	14.52	21	7.91**	B1, B4	19.04	22	1.59
626	A1, A5	9.68	8	(.66)[a]	B1, B5	14.56	13	(.51)
310 vs. 321	A2, A3	13.63	19	5.62*	B2, B3	17.04	19	1.02
511	A2, A4	15.51	18	1.12	B2, B4	8.16	10	.83
626	A2, A5	10.34	16	7.49**	B2, B5	6.24	6	(.02)
321 vs. 511	A3, A4	9.57	13	2.59	B3, B4	24.14	26	.74
626	A3, A5	6.38	11	6.04*	B3, B5	18.46	21	1.63
511 vs. 626	A4, A5	7.26	5	(1.35)	B4, B5	8.84	8	(.16)
		TRK-1X		TRADE KNOWLEDGE TESTS		TRK-1Y		
120 vs. 310	A1, A2	9.20	10	.17	B1, B2	17.60	19	.43
321	A1, A3	8.93	13	4.16*	B1, B3	20.80	26	5.81*
511	A1, A4	6.49	11	5.98*	B1, B4	12.27	10	(1.29)
626	A1, A5	6.22	7	.19	B1, B5	6.40	4	(2.30)
310 vs. 321	A2, A3	13.20	17	2.97	B2, B3	17.16	19	.74
511	A2, A4	9.60	10	.04	B2, B4	8.93	11	1.11
626	A2, A5	9.20	9	(.01)	B2, B5	5.28	6	.22
321 vs. 511	A3, A4	9.32	10	.11	B3, B4	11.96	13	.27
626	A3, A5	8.93	9	.00	B3, B5	6.24	7	.23
511 vs. 626	A4, A5	6.49	9	1.35	B4, B5	3.68	2	1.32

[a] Chi-square in parentheses ( ) indicates negative relationship.
*Significant at .05 level.
**Significant at .01 level.

Table 6

COMPARISON ACROSS ALL SAMPLES AND TESTS OF SETS OF VALID ITEMS IDENTIFIED IN PAIRS OF DIFFERENT MOS SAMPLES

Chi Square

MOS	310	321	511	626
120	1.54	18.67**	14.19**	(3.28)[a]
310		10.35*	3.10	7.68 (*)[b]
321			3.71	7.90*
511				1.16

Phi Coefficient

MOS	310	321	511	626
120	.07	.23**	.20**	-.10
310		.17*	.09	.15(*)
321			.10	.15*
511				.06

*Significant at .05 level (1-tailed test)
**Significant at .01 level (1-tailed test)

[a]Chi-square in parentheses ( ) indicates negative relationship.

[b](*) Narrowly fails .05 level of significance: chi-square of 7.78 required.

Median p-values for TRK-1Y (B samples) averaged .14 higher than for TRK-1X obtained in A samples. There was also a tendency for the Tool Knowledge items to be easier than the Trade Knowledge items, a difference possibly ascribable to the pictorial content of the former as contrasted to the greater verbal content of the latter. Average item validity coefficients clustered around a level of .18 in both samples and on all tests. The Tool Knowledge items were slightly more valid than the Trade Knowledge items.

Table 7

MEDIAN DIFFICULTY AND VALIDITY OF ITEMS SELECTED FOR MECHANICAL KNOWLEDGE SCALES

Test	Samples	Scale	p-value	Validity Coeff.
TK-1X	A	Construction	.69	.21
	A	Electrical	.62	.18
	A	General	.66	.16
	B	Construction	.70	.18
	B	Electrical	.72	.24
	B	General	.80	.16
TRK-1X	A	Construction	.52	.18
	A	Electrical	.56	.16
	A	General	.52	.15
TRK-1Y	B	Construction	.67	.17
	B	Electrical	.68	.20
	B	General	.67	.16

SUMMARY AND CONCLUSIONS

Three experimental information tests, the Tool Knowledge Test TK-1X and the Trade Knowledge Tests TRK-1X and TRK-1Y, were administered to two general enlisted input samples and to two samples each of five electrical and construction MOS. Item analysis yielded 25-item scales for heavy construction MOS, electrical maintenance MOS, and MOS in the general mechanical domain. The next research step is to obtain unbiased estimates of validity of the scales by cross validation of the Tool Knowledge scales and validity generalization and estimates of shrinkage for all scales. Information on the potential contribution of these scales as possible replacement tests for current ACB measures such as Mechanical Aptitude and Shop Mechanics will also be obtained.

REFERENCES

Helme, W. H. Differential validity of the ACB for courses in seven job areas. Technical Research Report 1118. April 1960.

Helme, W. H., Kotula, L. J., Tracey, E. A., and Anderson, A. A. Construction of mechanical information items for ACB replacement tests. April 1960.

APPENDIX

Average difficulty levels and validity coefficients for items comprising the 12 scales developed for Tool Knowledge and Trade Knowledge tests.

Table A-1

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE TWO CONSTRUCTION SCALES OF THE TOOL KNOWLEDGE TEST

Scale CA		Validity Coefficients[a]			Scale CB		Validity Coefficients[a]		
Item No.	Input p-value	MOS 120 (Sample A-1)	MOS 511 (Sample A-4)	Avg.	Item No.	Input p-value	MOS 120 (Sample B-1)	MOS 511 (Sample B-4)	Avg.
13	.80	22	19	21	8	.52	21	03	17
14	.58	23	13	20	20	.45	16	23	18
15	.35	13	36	21	48	.48	14	26	17
16	.52	22	23	22	50	.76	17	13	16
22	.92	20	28	23	51	.64	23	47	29
29	.38	15	30	20	52	.55	17	11	15
30	.90	40	01	27	61	.49	10	32	15
41	.64	21	29	24	62	.69	21	07	18
46	.58	30	46	35	66	.86	18	22	19
49	.52	16	34	22	69	.44	20	17	19
50	.76	26	06	19	70	.86	19	32	22
51	.64	23	14	20	73	.88	16	34	20
53	.38	20	15	18	77	.87	14	30	18
61	.47	28	09	22	78	.82	24	00	18
62	.69	27	26	27	80	.80	18	36	22
64	.88	08	42	19	81	.84	30	01	23
65	.72	21	35	26	85	.82	22	11	19
67	.80	28	49	35	86	.82	16	22	17
78	.82	21	14	19	94	.86	15	20	16
95	.41	25	27	26	98	.62	10	39	17
101	.64	15	34	21	102	.64	14	28	17
109	.84	27	12	22	103	.70	17	40	23
111	.75	20	29	23	104	.34	14	23	16
114	.78	18	27	21	113	.65	14	38	20
118	.70	21	23	22	118	.70	26	14	23

[a]Decimal points omitted.

Table A-2

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE TWO ELECTRICAL SCALES OF THE TOOL KNOWLEDGE TEST

Scale EA		Validity Coefficients[a]			Scale EB		Validity Coefficients[a]		
Item No.	Input p-value	MOS 310 (Sample A-2)	MOS 321 (Sample A-3)	Avg.	Item No.	Input p-value	MOS 310 (Sample B-2)	MOS 321 (Sample B-3)	Avg.
3	.86	10	21	16	3	.86	31	18	23
9	.44	40	08	22	14	.58	28	24	25
14	.58	49	07	25	22	.92	35	18	24
15	.35	32	16	23	32	.52	19	20	20
21	.49	06	23	16	48	.48	14	20	18
28	.51	20	22	21	51	.64	37	24	28
51	.64	23	15	18	53	.38	12	27	22
53	.38	27	08	16	56	.32	16	26	23
61	.49	39	13	24	58	.87	36	18	24
64	.88	21	14	17	60	.48	06	25	19
65	.72	30	17	23	64	.88	25	26	26
69	.44	34	04	17	65	.72	25	17	20
76	.78	13	21	18	66	.86	21	27	25
95	.41	29	08	17	72	.63	33	15	21
98	.62	26	13	19	77	.87	16	27	23
100	.33	23	16	19	81	.84	24	33	30
101	.64	19	13	16	85	.82	42	26	31
102	.70	16	19	18	86	.82	09	30	23
103	.70	23	17	20	89	.74	09	30	23
110	.52	23	12	17	98	.62	28	29	29
112	.69	19	22	21	101	.64	30	30	30
114	.78	22	11	16	103	.70	00	36	24
117	.79	27	11	18	109	.84	01	32	22
118	.70	27	08	16	113	.65	33	25	28
120	.36	39	08	21	114	.78	30	21	24

[a]Decimal points omitted.

Table A-3

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE GENERAL SCALE OF THE TOOL KNOWLEDGE TEST(A)

Scale GA		Validity Coefficients[a]					
Item No.	Input p-value	MOS 120 (Sample A-1)	MOS 310 (Sample A-2)	MOS 321 (Sample A-3)	MOS 511 (Sample A-4)	MOS 626 (Sample A-5)	Average
14	.58	23	49	07	13	10	20
15	.35	13	32	16	36	00	18
22	.92	20	10	15	28	11	16
25	.70	17	19	12	16	17	16
28	.51	09	20	22	10	06	14
29	.38	15	12	08	30	08	13
46	.58	30	15	10	46	12	21
51	.64	23	23	15	14	35	22
53	.38	20	27	08	15	-06	13
61	.49	28	39	13	09	19	22
62	.69	27	17	11	26	03	16
64	.88	08	21	14	42	20	18
65	.72	21	30	17	35	10	21
67	.80	28	26	03	49	10	21
90	.70	09	26	06	36	12	15
95	.41	25	29	08	27	-07	16
96	.66	17	32	04	16	08	15
98	.62	16	26	13	21	10	17
100	.33	06	23	16	17	19	15
101	.64	15	19	13	34	36	22
102	.70	25	16	19	-15	21	16
111	.75	20	14	00	29	09	13
114	.78	18	22	11	27	06	15
117	.79	15	27	11	24	09	16
118	.70	21	27	08	23	27	20

[a]Decimal points omitted.

Table A-4

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE GENERAL SCALE OF THE TOOL KNOWLEDGE TEST(B)

Scale GB		Validity Coefficients[a]					
Item No.	Input p-value	MOS 120 (Sample B-1)	MOS 310 (Sample B-2)	MOS 321 (Sample B-3)	MOS 511 (Sample B-4)	MOS 626 (Sample B-5)	Average
4	.73	10	11	16	22	22	15
13	.80	12	15	13	22	13	14
14	.58	10	28	24	05	00	14
22	.92	05	35	18	20	16	15
48	.48	14	14	20	26	-02	15
51	.64	23	37	24	47	00	25
58	.87	10	36	18	20	-14	14
61	.49	10	11	21	32	04	15
64	.88	08	25	26	26	01	16
66	.86	18	21	27	22	-19	16
73	.88	16	-01	14	34	09	15
77	.87	14	16	27	30	03	18
80	.80	18	-13	13	36	23	16
81	.84	30	24	33	01	17	25
85	.82	22	42	26	11	10	23
86	.82	16	09	30	22	02	18
90	.70	19	-03	35	03	26	19
94	.86	15	30	09	20	02	14
98	.62	10	28	29	39	00	19
101	.64	08	30	30	06	23	18
103	.70	17	00	36	40	18	23
109	.84	07	01	32	22	17	16
113	.65	14	33	25	38	-06	20
114	.78	12	30	21	-02	24	16
118	.70	26	06	24	14	23	21

[a]Decimal points omitted.

Table A-5

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE CONSTRUCTION SCALES OF THE TRADE KNOWLEDGE TESTS, TRK-1X and-1Y

Scale CX		Validity Coefficients[a]			Scale CY		Validity Coefficients[a]		
TRK-1X					TRK-1Y				
Item No.	Input p-value	MOS 120 (Sample A-1)	MOS 511 (Sample A-4)	Avg.	Item No.	Input p-value	MOS 120 (Sample B-1)	MOS 511 (Sample B-4)	Avg.
2	.61	15	14	14	1	.79	16	08	14
3	.89	22	03	16	5	.77	23	22	23
14	.80	10	28	16	11	.37	18	12	17
16	.59	30	35	32	13	.78	16	06	14
20	.52	17	34	23	17	.68	14	17	15
21	.65	21	50	31	20	.69	17	09	15
24	.45	19	16	18	30	.49	31	18	28
29	.52	29	23	27	37	.67	16	12	15
30	.65	20	15	18	38	.72	15	10	14
36	.43	21	19	20	45	.87	20	02	16
45	.52	29	20	26	47	.54	22	15	20
46	.37	04	38	15	49	.39	13	23	15
48	.80	29	09	22	51	.38	12	22	15
54	.50	14	22	17	54	.56	21	25	22
57	.34	13	15	14	59	.70	18	16	18
68	.82	27	29	28	61	.52	18	16	17
77	.35	23	13	20	64	.64	17	18	17
78	.53	15	16	15	74	.75	27	23	26
88	.48	21	28	23	76	.68	14	34	19
89	.37	10	20	14	77	.81	24	22	24
97	.50	15	26	19	81	.81	28	13	24
98	.62	05	32	14	87	.75	14	10	13
100	.61	36	25	32	89	.65	09	28	14
102	.38	11	23	15	97	.54	21	21	21
109	.79	16	13	15	105	.62	18	20	18

[a]Decimal points omitted.

Table A-6

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE ELECTRICAL SCALES OF THE TRADE KNOWLEDGE TESTS, TRK-1X and-1Y

Scale EX TRK-1X		Validity Coefficients[a]			Scale EY TRK-1Y		Validity Coefficient[a]		
Item No.	Input p-value	MOS 310 (Sample A-2)	MOS 321 (Sample A-3)	Avg.	Item No.	Input p-value	MOS 310 (Sample B-2)	MOS 321 (Sample B-3)	Avg.
12	.65	16	15	15	1	.79	04	23	17
14	.80	14	16	15	5	.77	20	20	20
16	.59	43	22	31	10	.87	43	25	31
17	.67	23	11	16	14	.80	32	21	25
20	.52	13	18	16	17	.68	37	23	28
21	.65	26	06	15	18	.65	26	14	18
23	.36	21	16	18	21	.81	11	25	21
24	.45	47	11	26	23	.59	32	13	19
28	.44	44	15	27	35	.61	37	21	26
30	.65	21	14	17	36	.89	34	08	16
36	.43	11	19	16	38	.72	28	23	25
40	.81	14	17	16	45	.87	25	30	28
43	.63	18	12	15	61	.52	28	14	19
45	.52	31	14	21	64	.64	24	14	17
46	.37	16	18	17	72	.68	30	10	17
61	.53	20	10	14	74	.75	11	24	20
69	.68	06	20	14	75	.38	21	28	26
70	.78	18	14	16	76	.68	33	14	20
72	.56	22	13	17	78	.45	44	15	25
78	.53	29	11	19	84	.48	-01	32	21
83	.33	21	14	17	86	.35	33	13	20
85	.76	15	13	14	87	.75	25	25	25
90	.46	26	09	16	90	.61	36	09	18
93	.37	27	23	25	97	.54	17	21	20
109	.79	20	12	15	99	.76	09	37	28

[a]Decimal points omitted.

Table A-7

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE GENERAL SCALE OF THE TRADE KNOWLEDGE TEST, TRK-1X

Scale GX		Validity Coefficients[a]					
Item No.	Input p-value	MOS 120 (Sample A-1)	MOS 310 (Sample A-2)	MOS 321 (Sample A-3)	MOS 511 (Sample A-4)	MOS 626 (Sample A-5)	Average
3	.89	22	02	18	03	08	12
14	.80	10	14	16	28	04	13
16	.59	30	43	22	35	-17	22
20	.52	17	13	18	34	01	16
21	.65	21	26	06	50	20	22
24	.45	19	47	11	16	-05	17
28	.44	-12	44	15	21	15	14
29	.52	29	06	08	23	16	16
30	.65	20	21	14	15	-11	12
36	.43	21	11	19	19	09	16
45	.52	29	31	14	20	16	22
46	.37	04	16	18	38	06	14
48	.80	29	05	14	09	04	14
54	.50	14	10	06	22	12	12
68	.82	27	09	08	29	02	14
77	.35	23	06	17	13	27	18
78	.53	15	29	11	16	-01	14
80	.83	14	17	10	08	13	13
83	.33	07	21	14	16	11	13
85	.76	13	15	13	-08	28	14
88	.48	21	03	16	28	11	15
93	.37	01	27	23	-02	13	13
97	.50	15	13	07	26	16	14
100	.61	36	19	03	25	17	20
109	.79	16	20	12	13	02	13

[a]Decimal points omitted.

Table A-8

AVERAGED DIFFICULTY LEVELS AND VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE GENERAL SCALE OF THE TRADE KNOWLEDGE TEST, TRK-1Y

Scale GY		Validity Coefficients[a]					
Item No.	Input p-value	MOS 120 (Sample B-1)	MOS 310 (Sample B-2)	MOS 321 (Sample B-3)	MOS 511 (Sample B-4)	MOS 626 (Sample B-5)	Average
5	.77	23	20	20	22	15	21
10	.87	05	43	25	16	17	18
14	.80	18	32	21	-17	05	14
17	.68	14	37	23	17	23	21
30	.49	31	18	10	18	-17	16
35	.61	13	37	21	03	08	16
37	.67	16	14	10	12	22	14
38	.72	15	28	23	10	14	18
39	.48	16	03	16	-02	25	13
45	.87	20	25	30	02	-02	18
49	.39	13	29	09	23	14	15
54	.56	21	10	15	25	14	18
61	.52	18	28	14	16	-01	15
64	.64	17	24	14	18	02	15
74	.75	27	11	24	23	00	20
75	.38	03	21	28	04	23	14
76	.68	14	33	14	34	-08	16
77	.81	24	-03	22	22	03	17
78	.45	11	44	15	07	-07	14
81	.81	28	03	23	13	-09	17
87	.75	14	25	25	10	03	16
89	.65	09	19	13	28	38	17
97	.54	21	17	21	21	21	20
99	.76	19	09	37	-09	-01	18
105	.62	18	28	09	20	-07	14

[a]Decimal points omitted.

Table A-9

DISTRIBUTIONS OF VALIDITY COEFFICIENTS OF ITEMS SELECTED AND ITEMS REJECTED FOR THE CONSTRUCTION SCALES OF THE TOOL KNOWLEDGE TEST

Validity Coefficients	SAMPLES							
	MOS 120-A		MOS 120-B		MOS 511-A		MOS 511-B	
	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.
.45 to .49					2		1	
.40 to .44	1				1		1	
.35 to .39	0				2	2	3	
.30 to .34	1	1	1		3	4	4	3
.25 to .29	6	1	1		6	0	2	4
.20 to .24	11	4	6	2	2	14	5	12
.15 to .19	4	15	10	8	2	12	1	6
.10 to .14	1	11	7	31	4	12	4	11
.05 to .09	1	27		25	2	17	1	16
.00 to .04		15		17	1	13	3	12
-.05 to -.01		11		8		10		11
-.10 to -.06		9		4		8		12
-.15 to -.11		1				3		6
-.20 to -.16								1
-.25 to -.21								1
-.30 to -.26								
-.35 to -.31								
-.40 to -.36								
TOTAL	25	95	25	95	25	95	25	95

Table A-10

DISTRIBUTIONS OF VALIDITY COEFFICIENTS OF ITEMS SELECTED AND ITEMS REJECTED FOR THE ELECTRICAL SCALES OF THE TOOL KNOWLEDGE TEST

Validity Coefficients	SAMPLES							
	MOS 310-A		MOS 310-B		MOS 321-A		MOS 321-B	
	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.
.45 to .49	1							
.40 to .44	1		1					
.35 to .39	2	1	3				1	2
.30 to .34	3	2	5	2			5	1
.25 to .29	5	4	4	5		1	9	1
.20 to .24	7	9	2	3	5	1	5	9
.15 to .19	3	17	3	9	6	2	5	16
.10 to .14	2	22	2	26	7	16		33
.05 to .09	1	7	3	16	6	15		16
.00 to .04		13	2	6	1	35		10
-.05 to -.01		10		12		15		4
-.10 to -.06		7		3		6		3
-.15 to -.11		0		7		4		
-.20 to -.15		1		5				
-.25 to -.21		2		0				
-.30 to -.26				0				
-.35 to -.31				0				
-.40 to -.36				1				
TOTAL	25	95	25	95	25	95	25	95

Table A-11

DISTRIBUTIONS OF VALIDITY COEFFICIENTS OF ITEMS SELECTED AND ITEMS REJECTED FOR THE CONSTRUCTION SCALES OF THE TRADE KNOWLEDGE TEST

Validity Coefficients	SAMPLES							
	MOS 120-A		MOS 120-B		MOS 511-A		MOS 511-B	
	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.
.50 to .54					1			
.45 to .49					0			
.40 to .44					0	1		1
.35 to .39	1				2	1		2
.30 to .34	1		1	1	2	1		2
.25 to .29	4		2	0	5	3	2	6
.20 to .24	6	3	6	0	5	8	7	10
.15 to .19	6	4	10	5	5	8	6	7
.10 to .14	5	14	5	18	3	13	5	13
.05 to .09	1	14	1	22	1	20	3	9
.00 to .04	1	22		23	1	9	1	14
-.05 to -.01		19		9		6		9
-.10 to -.06		5		4		9		6
-.15 to -.11		4		3		3		5
-.20 to -.16						3		1
-.25 to -.21								
-.30 to -.26								
-.35 to -.31								
-.40 to -.36								
TOTAL	25	85	25	85	25	85	25	85

Table A-12

DISTRIBUTIONS OF VALIDITY COEFFICIENTS OF ITEMS SELECTED AND ITEMS REJECTED FOR THE ELECTRICAL SCALES OF THE TRADE KNOWLEDGE TEST

Validity Coefficients	SAMPLES							
	MOS 310-A		MOS 310-B		MOS 321-A		MOS 321-B	
	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.	Sel.	Rej.
.45 to .49	2							
.40 to .44	1		2					
.35 to .39	0		3				1	
.30 to .34	1		6				2	
.25 to .29	4	2	5	8			4	
.20 to .24	7	7	3	5	3	2	8	7
.15 to .19	5	9	1	11	8	7	1	9
.10 to .14	4	18	2	11	12	7	7	16
.05 to .09	1	16	1	15	2	18	2	16
.00 to .04		10	1	10		23		14
-.05 to -.01		5	1	14		17		15
-.10 to -.06		11		4		6		5
-.15 to -.11		5		5		4		2
-.20 to -.16		1		1		1		1
-.25 to -.21		1		0				
-.30 to -.26				1				
-.35 to -.31								
-.40 to -.36								
TOTAL	25	85	25	85	25	85	25	85

Table A-13

DISTRIBUTIONS OF VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE GENERAL SCALES OF THE TOOL KNOWLEDGE TEST[a]

Validity Coefficients	"A" SAMPLES MOS 120	310	321	511	626	"B" SAMPLES MOS 120	310	321	511	626
.45 to .49		1		2					1	
.40 to .44		0		1			1		1	
.35 to .39		1		3	2		3	2	3	
.30 to .34	1	3		2	0	1	4	4	3	
.25 to .29	5	7		5	1	1	3	6	2	1
.20 to .24	7	5	1	3	2	2	2	6	8	5
.15 to .19	7	5	6	4	3	7	2	3	0	4
.10 to .14	1	3	9	3	7	10	3	3	2	2
.05 to .09	4		6	1	6	4	2	1	2	1
.00 to .04			3	0	2		2		2	8
-.05 to -.01				0	0		2		1	1
-.10 to -.06				0	2		0			1
-.15 to -.11				1			1			1
-.20 to -.16										1
-.25 to -.20										
-.30 to -.26										
-.35 to -.31										
-.40 to -.36										
TOTAL	25	25	25	25	25	25	25	25	25	25

[a]For any given sample, the total item validity distribution is the sum of the selected and rejected frequencies as shown in Tables A-9 through A-12. The distribution of rejected items is obtained by subtracting these distributions from the total distributions.

Table A-14

DISTRIBUTIONS OF VALIDITY COEFFICIENTS OF ITEMS SELECTED FOR THE GENERAL SCALES OF THE TRADE KNOWLEDGE TEST[a]

Validity Coefficients	Trade Knowledge 1X Samples MOS 120	310	321	511	626	Trade Knowledge 1Y Samples MOS 120	310	321	511	626
.50 to .54				1						
.45 to .49		1		0						
.40 to .44		2		0			2			
.35 to .39	1	0		2			2	1		1
.30 to .34	1	1		1		1	2	1	1	0
.25 to .29	4	3		5	2	2	6	3	2	1
.20 to .24	6	3	2	4	1	5	3	9	6	4
.15 to .19	5	4	8	5	5	8	3	3	5	2
.10 to .14	4	5	9	2	5	6	3	6	4	3
.05 to .09	1	4	5	2	3	2	1	2	1	2
.00 to .04	2	2	1	1	5	1	2		3	4
-.05 to -.01	0			1	2		1		1	4
-.10 to -.06	0			1	0		1		1	3
-.15 to -.11	1				1				0	0
-.20 to -.16					1				1	1
-.25 to -.21										
-.30 to -.26										
-.35 to -.31										
-.40 to -.36										
TOTAL	25	25	25	25	25	25	25	25	25	25

[a]For any given sample, the total item validity distribution is the sum of the selected and rejected frequencies as shown in Tables A-9 through A-12. The distribution of rejected items is obtained by subtracting these distributions from the total distributions.